

Feb. 7, 1961

C. D. CUPP

2,970,602

POSITIVE PRESSURE DEMAND REGULATOR

Filed April 23, 1956

3 Sheets-Sheet 1

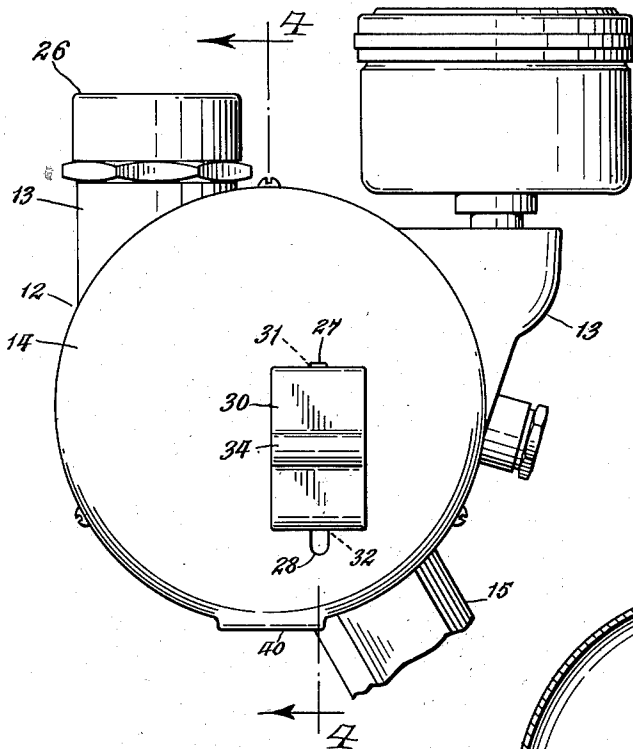


Fig. 1.

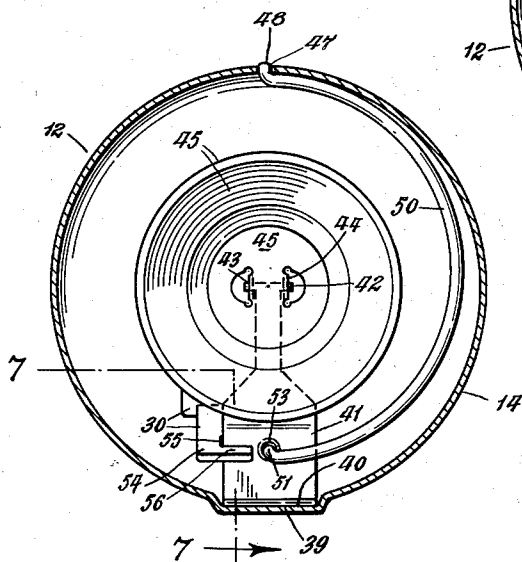


Fig. 2.

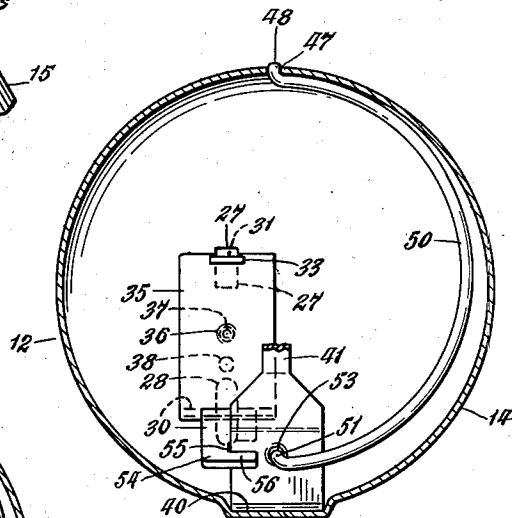


Fig. 3.

INVENTOR
Charles D. Cupp
BY
Walter H. Popp.
ATTORNEY

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3 Sheets-Sheet 2

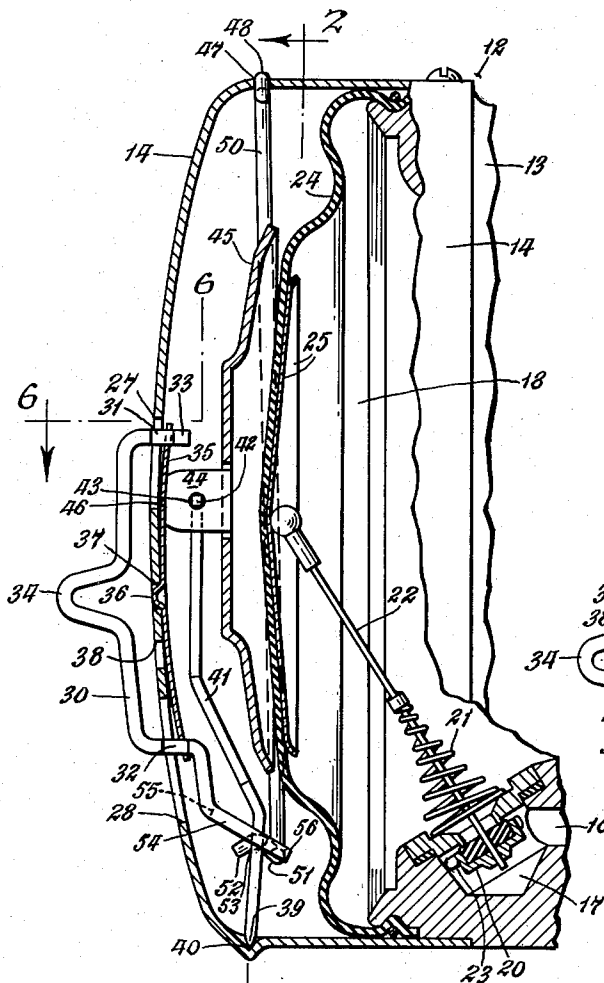


Fig. 4.

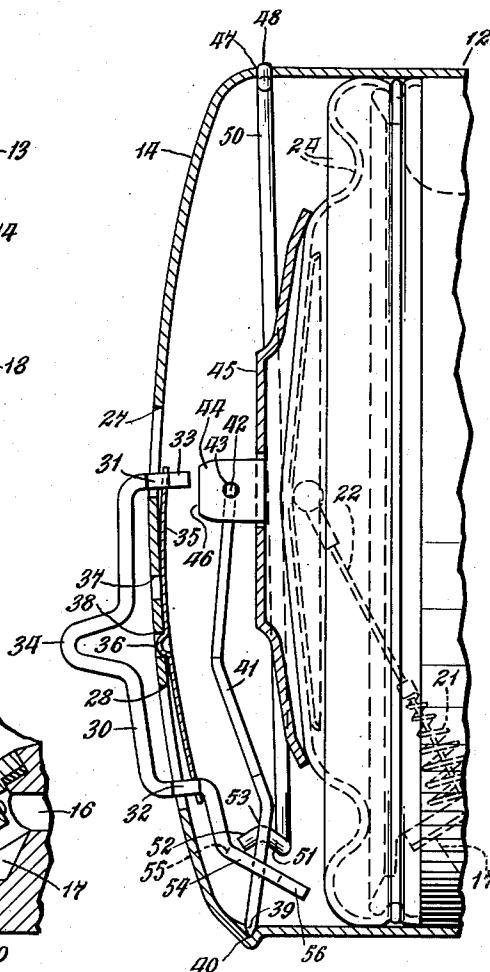


Fig. 5.

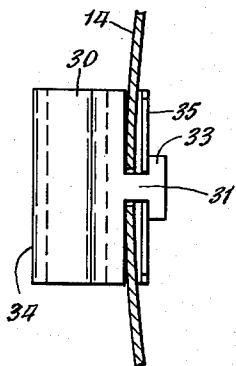


Fig. 6.

INVENTOR
Charles D. Cupp
BY
Walter H. Popp.
ATTORNEY

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C. D. CUPP

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3 Sheets-Sheet 3

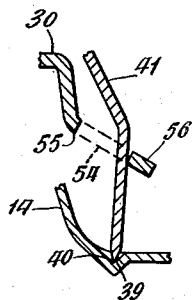


Fig. 7.

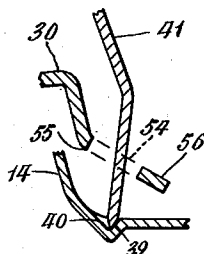


Fig. 8.

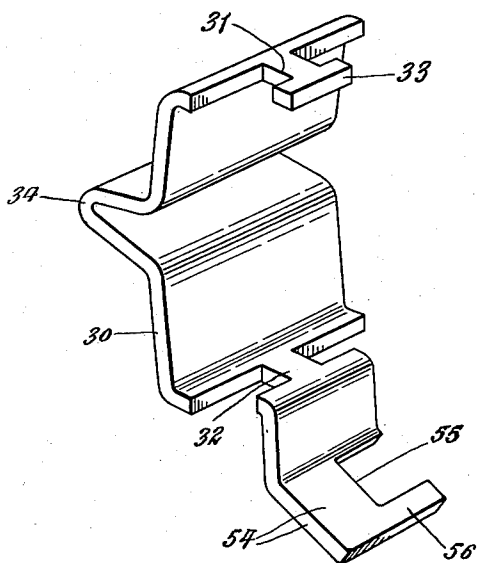


Fig. 9.

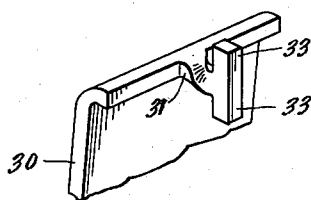


Fig. 10.

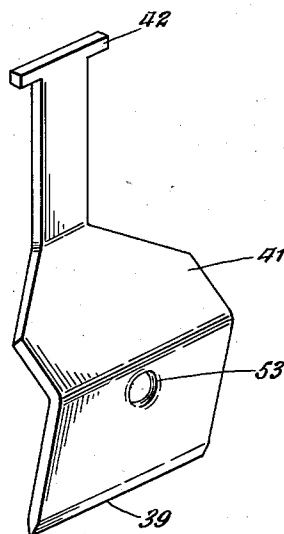


Fig. 11.

INVENTOR
Charles D. Cupp
BY
Walter H. Popp.
ATTORNEY

1

2,970,602

POSITIVE PRESSURE DEMAND REGULATOR

Charles David Cupp, Lancaster, N.Y., assignor to Scott Aviation Corporation, Lancaster, N.Y., a corporation of New York

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5 Claims. (Cl. 137—63)

This invention relates to a demand regulator for supplying pure breathing fluid to a person whenever he inhales, and only when he inhales, and relates more particularly to that type of demand regulator in which the pressure in the breathing chamber of the regulator is optionally maintained, whenever desired, above ambient pressure, so as to prevent any possibility of noxious, ambient gases being drawn during inhalation into the mask of the person who is using the breathing apparatus.

The principal object of the invention is to provide a demand regulator which will permit the inhalation of whatever volume of breathing fluid is required at approximately a uniform inhalation pressure. In other words, it is the principal object of the invention to permit the inhalation, whenever positive pressure is desired, of very large volumes of breathing fluid without requiring any substantially greater draft pressure than that required for small volumes of breathing fluid. Another object of the invention is to provide a simple and inexpensive means of enabling the positive pressure feature of the invention to be rendered inoperative whenever it is not needed. Other objects of the invention and practical solutions thereof are described in the following description and are illustrated in the accompanying drawings wherein:

Fig. 1 is a diminutive, front elevation of the preferred form of my improved positive pressure demand regulator.

Fig. 2 is a diminutive, vertical, transverse section thereof looking forwardly and taken on line 2—2 Fig. 4.

Fig. 3 is a diminutive, vertical, transverse section substantially like that of Fig. 2 but with some of the central parts of the regulator broken away.

Fig. 4 is a fragmentary, vertical, longitudinal section thru the regulator taken on line 4—4 Fig. 1, showing the pressure cover in its inoperative position.

Fig. 5 is a fragmentary, vertical, longitudinal section thru the regulator similar to Fig. 4 but showing the pressure cover in one of its operative positions.

Fig. 6 is a fragmentary, horizontal section thru the cover of the regulator, taken on line 6—6 Fig. 4.

Fig. 7 is a fragmentary, vertical, longitudinal section thru the lower end of the tilt lever and associated parts showing said tilt lever in its retracted or inoperative position and taken on line 7—7 Fig. 2.

Fig. 8 is a fragmentary, vertical, longitudinal section thru the lower end of the tilt lever and associated parts showing said tilt lever in its unimpeded or operative position.

Fig. 9 is a perspective view of the detent slide prior to its assembly in the regulator cover.

Fig. 10 is a fragmentary perspective view of the upper end of said detent slide showing the T-shaped, retaining tongue twisted so as to enable it to enter the vertical slot of the regulator cover.

Fig. 11 is a perspective view of the tilt lever.

The embodiment of the invention shown in the accompanying drawings will be described exactly as constructed and illustrated, but it is to be understood that the scope of the invention is not to be limited by the exact con-

2

struction shown but is only to be measured by the scope of the appended claims and the essence of the invention.

The casing 12 of this demand regulator consists of a main, cast aluminum body 13 and a stamped metal cover 14. For convenience we will assume that the regulator is used for regulating the flow of compressed air in a breathing apparatus which is surrounded by either air or water, at or relatively near sea level, but the regulator may also be used to control the flow of high pressure oxygen in high-altitude breathing apparatus.

Assuming, then, that compressed air is the breathing fluid being used, this compressed air is fed from a suitable source (not shown) into a pipe fitting 15 from whence it passes via a duct 16 (see Fig. 4) into a high-pressure, air-supply chamber 17. The flow of compressed air from this air-supply chamber 17 into a rear breathing chamber 18 is controlled by a demand valve 20. The latter is of the tilt type, and is resiliently urged toward its closed position by a conical spring 21 whose outer, narrow end is secured to the stem 22 of the valve. Lateral movement of the valve is limited by a plurality of guide ears 23 which project radially outward from its periphery.

This demand valve 20 is shown in closed position in Fig. 4 and is opened whenever the rubber diaphragm 24 together with its sheet metal backing plate 25 is caused to move rearwardly. When the demand valve 20 opens, it allows compressed air to pass into aforesaid breathing chamber 18 from whence it passes thru an outlet fitting 26 and thence into a suitable breathing mask or breathing mouthpiece (not shown).

The casing cover 14 is provided with a narrow, vertical, upper slit 27 and a narrow, vertical, lower slit 28, and slidably arranged in said slits is a sheet-metal detent slide 30. The latter (see Figs. 9, 6, 4 and 5) is formed to provide a narrow, upper neck 31 and a narrow, lower neck 32 which are slidably received within aforesaid upper and lower slits 27 and 28. The rear end of the upper neck 31 terminates in a rectangular, retaining head 33 which is first twisted 90°, as shown in Fig. 10 to enable the detent slide 30 to be assembled in the cover 14, and is then again straightened out to the position of Figs. 9, 6, 3, 4 and 5 so as to retain said detent slide 30 in said cover 14.

This detent slide 30 is arranged to slide vertically in the cover 14 to either one of two positions, i.e. either to the inoperative position of Figs. 4, 1, 2 and 3, or to the operative position of Fig. 5. To enable these movements to be conveniently effected manually, the detent slide 30 is curled forwardly, intermediate its upper and lower necks 31, 32, to form a front, thumb piece 34. Arranged against the rear face of the casing cover 14 is a vertical, rectangular, sheet metal, detent spring 35 whose upper and lower ends are medially and rectangularly cut away (see Fig. 3) to receive the narrow inner and outer necks 31, 32 of the detent slide 30. By this construction the central part of said rectangular spring 35 is resiliently urged forwardly (outwardly) against the rear face of the casing cover 14. To prevent accidental displacement of the detent slide 30 away from either one of its two positions, the central part of the spring 35 is forwardly dimpled at 36 and this dimple is adapted to be resiliently received within either the detent hole 37 (as in Fig. 4) or in detent hole 38 (as in Fig. 5), said holes being punched in vertical alignment in the casing cover 14.

The lower, front part of the cover is sharply creased or grooved downwardly to form a straight, horizontal, rocking valley or seat 40 which rockably receives the lower, straight, horizontal knife-edge 39 of the tilt lever 41 whose upper end is adapted to swing longitudinally in a vertical plane which is perpendicular to the rocking seat 40, the latter acting as a fulcrum for said tilt lever 41. The upper end of said tilt lever 41 is provided with

3

a horizontal pair of laterally projecting ears 42 which engage a companion pair of pivot holes 43 that are punched in the sheet metal lugs 44 which are folded back from the central part of the pressure plate 45. The latter is shown in its inoperative position in Fig. 4, its lugs 44 resting resiliently against the rear face of the casing cover 14 when the pressure plate 45 is in this inoperative position. While in this inoperative position, said pressure plate 45 is prevented from any noisy, idle rattling by so forming the front (outer) parts of said lugs 44 as to provide relatively long straight edges 46, the latter being preferably formed in a jig after the lugs 44 have been bent back.

Punched vertically in the upper front, central part of the cover is a hole 47 which loosely receives the sharply, upwardly bent end 48 of a C-shaped, wire spring 50, that lies in a substantially vertical, transverse plane. The lower end of this C-shaped spring 50 is first bent sharply upwardly and forwardly (outwardly) at 51, and then bent sharply downwardly and forwardly (outwardly) at 52, the crotch formed between said bent portions 51 and 52 being loosely received within a pivot hole 53 which is formed in the lower end of the tilt lever 41. The C-shaped spring 50 is a compression spring, and one of the effects of its compression resilience is to hold the knife edge 39 of the tilt lever 41 snugly down in its rocking seat 40.

The lower end of the detent slide 30 is bent rearwardly to form the substantially horizontal flange 54, one side of which is cut away to form a rectangular clearance opening 55 and a draw-back tongue 56. One side of the lower part of the tilt lever 41 is received within said clearance opening 55 (see Figs. 2, 3, 4, 5, 7, 8 and 9) and said draw-back tongue 56 is adapted to engage with the rear face of said tilt lever 41 and to draw it back to the inoperative position of Fig. 4 whenever the detent slide 30 is in its uppermost position. This effect is obtained by virtue of the curved shape of the casing cover 14, in conjunction with the inclination of the lower part of the tilt lever 41.

Whenever it is desired to have positive pressure in the breathing chamber 18, i.e., a pressure above ambient during inhalation and of course, during exhalation, as well, the detent slide 30 is manually pushed down to the position of Fig. 5. In this position the diaphragm 24 is pressed rearwardly by both ambient pressure and, in addition, by the resilient pressure of the C-shaped spring 50, the latter providing the "positive" part of the pressure. Because of its shape, the resilient resistance to compression of the C-shaped spring 50 does, to be sure, increase as the load is increased, but at a lower rate of increase. To put the matter in non-mathematical terms, if we compare an ordinary, linear spring of constant spring rate with this nonlinear, C-shaped spring 50 of variable spring rate, and with both springs subjected to the same stress in the maximum pressure position, we find that the effective stress in the more relaxed position is greater in the case of the C-shaped spring 50 than is the case with an ordinary spring. As a consequence, this C-shaped spring provides a greater flow of positive pressure air thru the demand valve 20 at higher rates of flow than could be obtained with an ordinary spring. This is desirable because maximum breathing efficiency calls for a substantially

4

equal inhalation pressure irrespective of the rate of fluid flow. In other words it is desirable to have a large fluid flow without building up a greater resistance to flow than occurs at a small fluid flow.

This desirable effect is only accomplished in relatively small degree by the use of the C-shaped spring 50. Most of the desired effect is obtained by what may be termed the dead-center type of linkage of the present invention. To be more precise, in Fig. 4 the pivot hole 53 of tilt lever 41 has moved forwardly (outwardly) until it almost lies in a plane passing thru rocking seat 40 and the axis of hole 47, i.e., it is almost in a dead center position. It is desirable that said pivot hole 53 never quite reach its dead center position because, in that case, the linkage would become locked and no resilient pressure at all be transmitted to the pressure plate 45. But said pivot hole 53 does come sufficiently close to a dead center position that the resilient effect of the C-shaped spring 50 upon the tilt lever 41 is very small in the position of Fig. 4 compared to the resilient effect it produces on said tilt lever 41 in positions like that shown in Fig. 5. In other words, the effective lever arm of the C-shaped spring 50 is very small for small openings of the demand valve 20, but is relatively large for large openings of said demand valve. Because of this, the positive pressure obtained by the C-shaped spring 50, i.e., its resilient urging of the demand valve toward its fully open position, is such that for inhalation the pressure in the breathing chamber 18 remains substantially the same irrespective of the rate of flow thru the demand valve 20.

I claim:

1. A positive pressure demand regulator for a breathing apparatus comprising: a casing; a demand valve arranged in said casing and supplied with breathing fluid under pressure; a diaphragm connected with said casing and adapted to actuate said demand valve whenever the user inhales; resilient means having a variable spring rate interposed between said casing and said diaphragm and arranged to urge said demand valve toward its open position; and linkage of the dead-center type connecting said resilient means with said casing.

2. A positive pressure demand regulator for a breathing apparatus as in claim 1, with means for preventing the linkage from quite reaching its dead-center position.

3. A positive pressure demand regulator for a breathing apparatus as in claim 1, with the resilient means consisting of a C-shaped spring.

4. A positive pressure demand regulator for a breathing apparatus as in claim 1, with the resilient means consisting of a C-shaped, compression spring.

5. A positive pressure demand regulator for a breathing apparatus as in claim 1, with means for rendering the resilient means either operative or inoperative.

References Cited in the file of this patent

UNITED STATES PATENTS

627,390	Cash	June 20, 1899
2,406,888	Meidenbauer	Sept. 3, 1946
2,597,961	Steffen	May 27, 1952
2,604,315	Patterson	July 22, 1952
2,639,881	Versen	May 26, 1953
2,760,507	Miller	Aug. 28, 1956
2,790,454	Benzel	Apr. 30, 1957